GREENLAND RESEARCH AND DEVELOPMENT PROGRAM

U.S. ARMY POLAR R&D CENTER

1959 AFTER OPERATIONS REPORT

DEPARTMENT OF THE ARMY

1 JAN. 1960

AFTER OPERATIONS REPORT, GREENLAND R&D PROGRAM, 1959

PREFACE

The authority for the 1959 Department of The Army Research and Development Program in Greenland is contained in AR 70-15.

The U. S. Army Polar R&D Center was the coordinating and supporting organization for the research and development projects, tests, and other specifically directed operations in Greenland.

The Department of The Army and government agencies supplied supervisory personnel for specific R&D projects. These participating agencies were:

Chemical Corps

U. S. Army Chemical Corps Proving Ground (USACPG), Dugway, Utah.

Corps of Engineers

U. S. Army Engineer Research and Development Laboratories (USAERDL), Fort Belvoir, Virginia.

U. S. Army Snow, Ice, and Permafrost Research Establishment (USASIPRE), Evanston, Illinois.

U. S. Army Engineer Waterways Experiment Station (USAEWES), Vicksburg, Mississippi.

U. S. Army Map Service, Washington, D. C.

Arctic Construction and Frost Effects Laboratory (ACFEL) of the U. S. Army Engineer Division, New England, Corps of Engineers, Boston, Massachusetts.

Human Resources Research Office

The Human Resources Research Office (HumRRO), George Washington University, Washington, D. C.

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Medical Corps

U. S. Army Medical Research Laboratory (USAMRL), Fort Knox, Kentucky.

Ordnance Corps

Office of Ordnance Research, Duke University, Durham, North Carolina.

Ordnance Tank-Automotive Command, Detroit Arsenal, Center Line, Michigan.

Quartermaster Corps

U. S. Army Quartermaster Research and Engineering Command, Natick, Massachusetts.

U. S. Army Quartermaster Field Evaluation Agency, Fort Lee, Virginia.

Signal Corps

U. S. Army Signal Research and Development Laboratory (USASRDL), Fort Moumouth, New Jersey.

U. S. Army Electronic Proving Ground (USAEPG), Fort Huachuca, Arizona.

Transportation Corps

U. S. Army Transportation Environmental Operations Group (USATREOG), Fort Eustis, Virginia.

United States Continental Army Command

U. S. Continental Army Command (USCONARC), Company D, 1st Battle Group, 12th Infantry, Fort Lewis, Washington.

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I. INTRODUCTION

This report outlines the accomplishments of the 1959 U. S. Army Research and Development Program in Greenland. This was the most productive year of the Greenland Research Program and was the first in which all seven Department of The Army Technical Services participated. In addition to 44 R&D Projects, considerable effort was devoted to construction of facilities at Camp Tuto and Camp Century in anticipation of year-round operation during 1960-61.

Assistance rendered by the District Engineer, Eastern Ocean District contributed greatly to the 1959 program. Invaluable support was furnished by the U. S. Air Force in flying missions and resupply from Sondrestrom, evacuating personnel from Narsarssuak, and providing logistical support at Thule.

II. SCOPE

The original project scopes and major requirements are outlined in Figures 1 and 2. These charts were compiled from information furnished to U. S. Army Polar R&D Center by the technical services during the planning period.

The R&D program was accomplished as described in Section V of this report. Complete reports of project activities and results will be published by the responsible research agencies after the data gathered during 1959 are compiled and analyzed.

A summary of the extensive center activities in support of the R&D programs is contained in Section VI.

III. ORGANIZATION AND MISSION

The organization of the U. S. Army Polar R&D Center for 1959 is shown in Figure 3. The mission of the Center for 1959 was:

a. To provide command and staff supervision, coordination, and planning for research and development agencies operations in

isolated arctic regions.

b. To provide administrative, logistical, communications, and maintenance support for research projects operating under Center control.

The organization of research and development agency personnel, attached to the Center in the field during 1959, is shown in Figure 3. The mission of these agencies was to accomplish the project work as programmed.

IV. CHRONOLOGY

The U. S. Army Polar R&D Center moved from Fort Belvoir, Virginia to Northern Greenland in seven increments during the period 9 April to 18 May 1959. Research and development projects were active in field work from 15 April to 3 September 1959. The locations of the camps which were operated to support these projects are shown in Figure 5.

The U. S. Army Polar R&D Center returned in 9 increments to Fort Belvoir, Virginia, during the period 4 to 18 September 1959.

V. PROJECT ACTIVITIES

Final project reports cannot be prepared until evaluation and interpretation of data gathered is completed. These reports will be published by the responsible agencies; however, the following paragraphs contain a preliminary summary of objectives realized.

Chemical Corps

Numbered Chemical Corp Projects.

Project CC - 1 - 59 Meteorological Studies (CML, Project Leader: CWO Alton L. Kelly, CML). Meteorological data was obtained from the Signal Corp Met Team and used in support of daily environmental testing. Data was also compiled for later analysis and study in connection with other Chemical Corps projects.

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PROJECTED 1959 RESEARCH AND DEVELOPMENT PROGRAM — GREENLAND

SHEET NO. 1

	PROJECT	AGENCY	PROJ LDR	SCOPE	LOCATION	AGENCY PERSONNEL	ER & DD PERS'L	WEASELS	WANIGANS	SLEDS	SPECIAL EQUIPMENT	TIME	AIR SUPPORT	REMARKS
1.1	Approach Roads	WES ACFEL		a. Remedial work on berms to correct distress resulting from perching action between stations 30 + 00 to 50 + 00. b. Research and investigation on construction and maintenance of bridges in ice. c. Continuation of drainage observations. d. Accomplish additional corrective work on Tuto-"P" Mt. Road.	TUTO	6	4				1 3/4 Ton TK 1 Jeep 1 Survey Set	1 Aug. 1 Sept.	5 hrs (H)	
3	Snow Compaction (with proj. 35)	ERDL SIPRE	Kelly Waeri	Construct a test section of a runway at Site II, using following techniques: a. Process a "Peter-snow" base with use of Peter Miller and Snowblast. b. Process a wearing surface with heat processor (Pulvimixers and T-5 Peshore).	SITE II	5	17	3		3 - 1 Ton	3 D-8's 2 Bros Rollers 1 Sheepsfoot 5 Corrugated Rollers 1 Shop 2 Herman Nelson 1 Peter Plow 1 Snowblast 3 Pulvimixers 1 Adams-grader	20 June 15 Aug.		Produce runway at Site II suitable for wheeled aircraft up to C-54 class.
6	Snow Trafficability	WES SIPRE		a. Conduct studies to determine: (1) Vehicular traffic limitations in bottom of cut-and-cover trenches. (2) Proper technique for construction of railway in trenches. b. Test tie, ballast, and rail combination under traffic.	SITE II	2	6				Use of Peter Plow Grader Impact Compactor Spike Driver Watering Cart Track & Ties Ballast Maker	20 July 1 Sept.		
7	Trail Marking Wear Test	USAFRADC		a. Lay on snow surface 60 miles of trail marking wire. b. Install receiver equipment in vehicles	TUTO MI-30		6	2	1 (12 man)	2 - 10 Ton	1 LGP Tractor Special Trail Equipment	June		1 week only
8.1	Crevasse Detector Wear Test	USAFRADC ERDL	Miller	a. Assembly and modification of 2 detectors. b. Testing of equipment conducted in conjunction w/swings.	TRAIL	1	2					June		
8.2	Crevasse Location and Mapping (with proj. 28.2)	SIPRE WES	Hanson	a. Conduct pilot study for "Cold Deck" at Houghton, Michigan during winter of 1958-59. b. Modify existing instrumentation as required and test in Blue Ice Valley during 1959 summer season.	TUTO (BASE) BLUE-ICE VALLEY	2		2	1 (4 man)	1 - 1 Ton		1 May 15 June	40 hrs (F)	
13.1 13.2	Snow Structures	SIPRE	Waterhouse Bender	a. Pilot studies in cooling of Under Snow Camps. b. Construct a hemispherical roof using cut-and-cover method. c. Construct under-cut subsurface roadway test sections at Camp Century Site and at a location to be selected in the marginal zone for purpose of determining feasibility and of perfecting techniques. d. Construct trial camouflet storage chambers at Site II.	SITE II CAMP CENTURY	6	10	1	1 (Mess)	1 - 10 Ton	Peter Plow Crane Ventilating Equipment T-5 Buildings (3)	1 June 1 Sept.	10 hrs (F)	It is anticipated these projects will be consolidated.
14	Water Supply and Waste Disposal	ERDL	Schmidt	a. Install and operate a steam operated type water supply system (600 gal/day at Site II). b. Investigate area of subsurface contamination resulting from sewage disposal pits (wells) in snow. Based on findings determine proper location of water supply source in relation to disposal pits, i.e., minimum safe distance, relative elevations, etc.	SITE II	2	6	1		1 - 1 Ton	Peter Plow 2 days Suitable Storage tanks: piping and heaters Fuel oil: 6000 gallons	1 June 15 Aug.		Water produced will be used to supply Site II.
22.1	Ice Tunnel	SIPRE	Abel	a. Complete excavation for 25-man camp in 1958 tunnel. b. Prepare for installation of inner structures. c. Continue observation of closure rates. d. Prepare conceptual designs for: (1) water supply system. (2) Waste disposal system. (3) Ventilation system. (4) Heating system.	TUTO	10	19				3 ½ Ton TK Dozer Compressor 2 Jamesways 1.0 KW Generator (Present equip. set up)	1 June 1 Sept.		Build to plan layout, including storage, shops, and quarters.
22.2	Ice Tunnel Instrumentation	SIPRE	Butkovich	a. Reinstrument new tunnels, employing techniques resulting from observations already completed. b. Continue observations of existing tunnels.	TUTO	1	2	1		1 - 1 Ton	1 5 KW Generator 5000 ft telephone wire 1 ½ Ton TK Steel Plate	15 June 25 Sept.		
23.1	White-Out Studies	SIPRE	Kahan	a. Continue with attempts to disperse whiteouts by seeding with silver iodide crystals. b. If successful, conduct studies to determine suitable means of seeding whiteout areas, including aircraft, rockets, balloons, etc.	SITE II	2	1	1 w/radio	1 (8 man)	1 - 1 Ton	That made available for use last season.	15 June 1 Sept.	10 hrs (H)	
25	Deep Thermal Core Drilling	SIPRE	Lollak	a. Test thermal core drilling equipment. b. Develop efficient techniques for use of equipment.	TUTO	2	2				1 ½ Ton TK	1 July 30 Aug.		
25.3	Drill Hole Measurements	SIPRE	Hansen	a. Continue annual measurement of Site II drill hole. b. Develop equipment and techniques for precision measurements of temperature and deformation of deep holes drilled in ice or frozen ground.	SITE II	(2)						20 May 5 June		
28.1	Aerial Photographic Techniques	SIPRE	Poulin Frost McAnerney	a. Soil Movement Studies: (1) Study photographically the development and rates of movement of patterns produced in a soil subjected to repeated cycles of freezing and thawing. (2) Rephotograph areas which were previously photographed in the Thule-Tuto area during 1955 and 1956. (3) Blue Jay: (a) Repeat detailed inspection of runway, tank farm, hangar, and other major facilities at Thule Air Base. (b) B-Site Survey: Observe construction and subsequent performance of the facility at B-Site for evaluation of airphoto methods.	THULE	2	1				3.5 KW Generator 1 ½ Ton TK 1 3/4 Ton TK	1 May 30 Aug.	10 hrs (H)	
28.2	Aerial Photographic Research Specifications (Cold Deck)	SIPRE	Malerren Leighty Rinker	a. Study various sensors to record snow, ice, and frozen ground features and their use to detect under snow and under ice targets. b. Determine optimum conditions for photographing snow and ice surfaces. c. Correlate photographic images with existing snow and ice properties and compare with thermal images obtained with the radiometer (Project 8.2).	TUTO THULE	6 24 USAF	8 (5) (part time)				3 ½ Ton TK 1 3/4 Ton TK 30 KW Generator	15 April 30 July	30 hrs (H)	Transport AF personnel to Thule for Flights
31	Principles of Oversnow Vehicle Design	SIPRE	Lavon	a. Modify the test equipment at Houghton, Michigan during the winter of 1958-59. b. Conduct tests of subsurface ski principle in Greenland during summer of 1959.	SITE II	2	2	1	1 (4 man)			1 - 15 June		Transportation of device to Site II
33	Pile Testing	SIPRE	Costes	a. Continue observations of pile clusters now loaded. b. Install and load trial-footers placed on "Peter Snow". c. Design, install, load, and observe trial foundations suitable for nuclear power plants.	SITE II	2	4	1	1 (8 man)	1 - 1 Ton 2 - 10 Ton	Use of Peter-plow D-4, D-8 with blade, heater, *200 barrel oil, pipe, blower.	15 June 30 Aug.		
34	Seismic Research	SIPRE	Roethlisberger	a. Make seismic profile of bed rock at Site II over same location as the 1956 profile in an attempt to determine ice cap movement at that location. b. Conduct soundings in the tunnel excavated in permafrost in the Tuto area. c. Reconnoiter glaciers in the Tuto vicinity to determine the feasibility of making a survey on a fast moving glacier.	TUTO SITE II	2	1	1	1 (4 man)	1 - 1 Ton	SIPRE seismic equipment	16 June 3 Sept.	12 hrs (H)	
R-1	Tunneling in Permafrost	SIPRE ACFEL	Abel	a. Study possible techniques by: (1) laboratory trials with cutting tools. (2) Restudying the thaw-dig principle. (3) Letting contracts with industry for development which laboratory tests and studies indicate may be feasible. b. Conduct field tests in Greenland, at a location approximately 1 mile west of Tuto. Use conventional equipment.	TUTO	4	10				Expert in handling explosives. Tunnelling timber and braces. Bulldozer, shovel, trucks for clearing portal.	1 June 1 Sept.		
R-2	Pressurization of Ice Tunnels	SIPRE	Abel	a. Study rebound characteristics of ice and the effect that low pressures have in reducing plastic flow. b. Prepare plans for testing concept in 1960 should the study indicate that a significant reduction in the rate of plastic failure is possible.	TUTO	1	0					1 June 59 31 Aug 60		
R-2	Camp Planning	[illegible] SIPRE WES	Evans	a. Prepare master plan, layout, and detailed design and specifications for Camp Century. b. Prepare for construction of Camp Century during FY 60.	TUTO CENTURY	3		1	1 (4 man)	1 - 1 Ton	Survey and layout instruments	1 Aug. 15 Sept.		Preparations for erection during the 1st part of 1960.
R-3	Structure of Greenland Ice Cap	SIPRE	Ragle	a. Study of the ice cap made from the vicinity of Sondrestrom Fjord to the Southern tip in the vicinity of Narsarssuaq. b. Make meteorological and topographical observations along the route. c. SIPRE scientist to accompany TREOG tractor swing from Tuto to Nyboes Land and conduct snow studies along the route.	Camp Tuto, Sondrestrom, Nyboes Land, Vicinity of Narsarssuaq	2	3	2 SIPRE	2 (4 man)		C-130 Aircraft	15 May 5 Sept.		Aircraft requirements are being coordinated by OCE.
				TOTAL		63	109	17	10	15	See Individual Projects		107 hr	

* NOTE: Wear test to be conducted in conjunction with mileage on 2 D-8 LGP tractors equipped with series D 343 engine and [illegible] wanigans.

Figure 1. Projected Research and Development Projects, 1959

Project CC - 2 - 59 Protection and Decontamination (CML, Project Leader: CWO Alton L. Kelly, CML). This season's activity was limited to obtaining basic data concerning use of snow and ice as materials for the construction of protective shelters. Data will be analyzed for use in future tests.

Project CC - 3 - 59 Combat Surveillance Counter Measures (CML). No field work was conducted.

Project CC - 4 - 59 Classified (CML). No field work was conducted.

Unnumbered Chemical Corp Projects.

Cycle "O" Environment Testing (CML, Project Leader: CWO Alton L. Kelly CML). The project objective was to obtain data necessary to determine the effects of polar environment on standard and experimental Chemical Corps items.

Color smoke grenades, incendiary grenades, smoke pots, and smoke generators were tested on the ice cap. Test results were noted and recorded on still and motion film from the ground and aircraft. Further analysis and study of data is required.

Corps of Engineers

Numbered Engineer Projects.

Project 1.1 - Approach Roads (USAEWES/ACFEL, Project Leader: Mr. Robert M. Davis ACFEL). Longitudinal profiles were again determined on the Ramp Road leading from Tuto onto the Ice Cap and on the Transverse Road leading to the Ice Tunnel. Cross sections were also taken at selected points on the Ramp and Transverse roads. Subsurface ice movements were measured by use of inclinometer tubes at three points along the ice ramp parallel to the roads. A profile of the ice edge was made from the base of Ramp Road to a point 600 feet south for the purpose of determining ablation in that vicinity. Thermocouples were used to record subsurface temperatures in three locations under the Ramp Road; in two locations off the road in test lanes #1 and #4; and in bore holes D5 and D6 located in permafrost near the Tuto end of Ramp Road.

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SHEET NO. 2

NUMBER	PROJECT	AGENCY	PROJ. LDR.	SCOPE, OBJECTIVES	LOCATION	AGENCY PERSONNEL	WEASELS	[illegible]	SLEDS	SPECIAL EQUIP.	TIME	AIR SUPP'T	REMARKS
TC 1 - 59	Experimental Polar Transport Operations	[illegible]		Scope: A series of overenow movements will be conducted to include Lead Dog II. Objective: To locate suitable ice-cap access routes on the northeast and northwest coasts; to test concepts of operation and equipment.	Tuto, Nyeboe Land	100 (estimate)				Snow Train Wheeled Trailers D-8 LGP Others	May - Sept	60 (H) 60 (F)	2 SIPRE personnel are required to do glaciological work.
TC 2 - 59	Environmental Testing of overanow equipment	[illegible]		Scope: User test of certain items. Equipment will be used on ice-cap operations. Objective: Extended engineering tests of Snow-Train, Rolling Fluid Transporters and other items under ice-cap conditions.	Tuto and Ice-Cap	12				Snow Train Rolling Liquid Transporter	May - Sept		2 SIPRE personnel are required.
SC 1 - 59	Meteorological Support	EPG		Scope: Operate meteorological stations at two locations near Tuto and one near Site II. Objective: Gather meteorological data for R&D projects.	Tuto, Site II	23				2 ½ Ton TK	May - Oct		2 micrometeorological stations along Ramp Road at Tuto. Weather Station Site II.
SC 3 - 59	Meteorological Stations, Upper Air	Signal Corps Labs	Dr. Weickmann	Scope: A five-year coordinated meteorological program from three year-round stations. Phase 1 will consist of erecting one station on the land area near Tuto-F Rd. road junction during 1959 season. Objective: Gather year-round data on upper atmospheric conditions.	Tuto and Vicinity	5 (estimate)				1 ½ Ton TK part time	May - Sept	20 (F)	
SC 3 - 59	Geomagnetic Measurements	Signal Corps Labs	Dr. Weickmann	Scope: Measurements of the earth's magnetic field in Greenland. Objective: Collection of data.	Site II	1 (estimate)	1		1 1-Ton	Power 5 KW Wire Loop enclosing 36 square miles	June - Sept	6 (H)	Requires an area of approximately 36 sq. miles with no other activity. Lay wire loop by helicopter.
SC 4 - 59	Giaminni Data and Integrating System	Signal Corps	Dr. Weickmann	Scope: Installation of Giaminni Automatic Data and Integrating System. Objective: Collection of data.	Tuto	2 Civilians				1 ½ Ton TK	May - June		Provide space and power at Tuto for USAEPG Equip.
SC 5 - 59	Mapping of Snow Drift Areas	Signal Corps	Dr. Weickmann	Scope: Map snow drift area within 100 mile radius of Tuto, by aircraft. Objective: Collection of data.	Tuto	2 Civilians					July	20 (F)	
SC 6 - 59	Atmospheric Electricity	Signal Corps	Dr. Weickmann	Scope: Establish recording station at Site II to record atmospheric electricity. Objective: Collection of data	Site II, Tuto	3 Civilians				1 ½ Ton TK	May - Sept		Coordinated activity W/Ionosphere station Thule. Provide space and power at Tuto for USAEPG equip.
QM 1 - 59	Micrologistics and Human Factors Involved in Small Unit Capabilities in Polar Areas	QMR&E Center Lab.		Scope: To establish and conduct special small unit operations as a means of studying integrated QM equipment systems. Objective: To determine engineering adequacy of current and experimental QMC equipment for polar operations.	Site II	5 Officers 15 EM 5 Civilians	2 (1w/radio)		3 1-Ton	16 pr skis 3 EE8 phones	15 June - 15 Sept.		Three camps to operate within 10 miles of Site II 5 days in field 2 days Site II 2 man liaison team quartered at Site II
QM 2 - 59	Polar Field Service Center	QMR&E Center Lab.		Scope: To establish and operate prototype QMC type service centers to study feasibility of simplifying and intergrating field support in polar regions. Objective: To develop engineering plan for equipment complex of polar service concept.	Tuto	1 Civilian				Field laundry equipment 1 ½ Ton TK	1 April - 1 October		Equipment will be air shipped to Greenland.
QM 3 - 59	Human Factors Research of QM Problems Associated with Missile Sites & Ice Tunnel	EPRD		Scope: To conduct studies of operations of missile systems and subsurface living from the QM areas of interest. Objective: To determine limitations on QM equipped personnel imposed by QM equipment.	Tuto, Thule	1 Officer				1 ½ Ton TK			
QM 4 - 59	Micrometeorological Studies	EPRD		Scope: To make micrometeorological observations. Objective: To determine magnitude of meteorological conditions encountered in ice cap operations.	Tuto, Site II	2 Civ (2 weeks) 1 Civilian				Sig. Corps Met. Equipment	May - Oct		Conducted in conjunction with Signal Corps Project 1.
MC 1 - 59	Adaptation of Man to Polar Environment	USAMRL	Dr. Davis	Scope: Ten previously studied human volunteer subjects will live in a field camp at mile 3 near Tuto. Objective: Data will be taken on adaptation of personnel to the field conditions.	Mile 3	15	2			2 days Peter Plow 1 Jamesway 1 30 KW Generator 13 pr skis Camping Equip.	15 Oct. - 30 November		Construct a cold room "Snow Cave" to provide controlled cold. (4 man days estimate)
MC 2 - 59	Microbiology	USAMRL		Scope: Bacteria samples will be taken from lake Tuto and Camp Tuto, and Fistclench vicinity. Objective: Data will be gathered on types and spread of bacteria.	Tuto & Site II	4				16' x 16' space for Laboratory	1 May - 1 Sept		Laboratory in Camp Tuto dispensary will be used.
MC 3 - 59	Psychological Studies	USAMRL		Scope: Study of the psychological effects of isolation and white-outs on personnel. Objective: Gather data on environmental effects.	Tuto, Mile 3, Site II	3					1 April - 15 May		
MC 4 - 59	Investigation of Hematocoesis	USAMRL		Scope: Study the various components of the blood of individuals before, during and after residence in Greenland. Objective: Data to confirm or cast further doubt on the existence of "Arctic Anemia" as previously reported on this subject.	Tuto, Site II	3							Use 20 military personnel of PRADC on a volunteer basis 10 of which will be at Camp Tuto and 10 of which will be at Camp Fistclench.
[illegible] 1 - 59	Test of Measurement Tools	HUMRRO		Scope: Test measurement tools to measure morale, training, leadership. Objective: To develop information and hypotheses to be used in field testing.		2 Civilians 2 Military	1			1 ½-Ton TK	30 April - 1 Sept.		Use military personnel of PRADC approximately 14 man days per week.
CC 1 - 59	Micrometeorological Studies	CML R&D		Scope: A study of the micrometeorological phenomena of Greenland to correlate the phenomena with the parameters of dissemination of CBR agents. Objective: To determine the behavior of such agents and to determine the optimum method for dissemination.	Tuto, Site II	5 Military							400 square feet of labratory space needed. Conducted in conjunction with Signal Corps Project 1. (Unfunded) Probably cannot be accomplished until the 1960 season.
CC 2 - 59	Protection and Countermeasures	CML R&D		Scope: Test penetration of aerosols into undersnow areas. Objective: Determine collective protection requirements. Determine methods of decontamination.	Tuto, Site II	(5)						6 (H)	(Unfunded) Probably cannot be accomplished until the 1960 season.
CC 3 - 59	Combat Surveillance Countermeasures	CML R&D		Scope: Conduct tests to determine capabilities of infrared and countermeasure screens in Greenland. Objective: To determine effectiveness under polar environment.	Tuto, Site II	(5)							(Unfunded) Probably cannot be accomplished until the 1960 season.
CC 4 - 59	Disposal of Radioactive Waste	CML R&D		Scope: Survey of area and possibilities for disposal of waste. Objective: Develop methods and techniques for disposal of radioactive waste in Greenland.	Tuto, Site II	(5)							(Unfunded) Probably cannot be accomplished until the 1960 season.
ORD 1 - 59	Fuels and Lubricants Testing			Scope: Testing of various fuels and lubricants on Ord. vehicles in polar regions. Objective: Investigate unusual technical aspects of lubrication in polar regions.	Tuto, Thule	3							Testing will be in conjunction with normal PRADC operations.
ORD 2 - 59	Human Engineering Studies			Scope: Surveillance of 7th AAA Missile Sites and Equipment. Objective: Determine problems of operation of Ordance Missile Equipment in polar regions.	Tuto, Thule	3				1 ½-Ton TK	Jan - Sept.		Quarter with troops at AAA Sites
ORD 3 - 59	Vehicle Over-Snow Mobility	Tank-Auto. Center		Scope: Investigate vehicle over-snow mobility, and related criteria by observing PRADC operations. Objective: Develop concepts of land locomotion research.	Tuto, Site II	2							
CONARC 1 - 59	Small Unit Operations	CONARC		Scope: Conduct platoon-size tactical operation on the ice-cap. Objective: Gather data for troop operations in polar regions.	Site II & Vicinity	50	3 (2w/radio)	3 (12 man)	3 1-Ton 1 10-Ton	50 pr. skis Camping Equipment	15 Aug - 15 Sept.	10 (H)	Designed for use as Emergency Shelters.
				TOTAL		[illegible]	9	3		See Individual Projects		[illegible]	
				SUBTOTAL		Agency Personnel 353 / [illegible] Personnel [illegible]	[illegible]	13	23	See Individual Projects		[illegible]	

[illegible]

Figure 2. Projected Research and Development Projects , 1959

Project 3 and 35 - Snow Compaction (USAERDL/USASIPRE, Project Leader: Mr. Albert F. Wuori, USASIPRE). Part I (USAERDL). Test results on the T-5 Snow Packer are inconclusive due to the erratic operation and lack of experienced personnel, both civilian and military, assigned to the project. Approximately 4000 feet of a test strip was completed prior to complete mechanical failure of the equipment.

Part II (USASIPRE). Performance tests were conducted on both the Taylor Snow Blast and the Peter Snow Miller. Six test lanes were constructed with the Snow Blast before mechanical failure of the transfer case caused the suspension of further tests. Two lanes were constructed using the Peter Snow Miller. However, testing could not be completed due to failure of the Snow Packer.

Project 7a - Trail Marking (USAERDL/USAPR&DC, Project Leader: Mr. Harold K. Miller USAERDL). During April 1959, Trail wire was installed on the snow surface from mile 3 to mile 13 along the Site II Trail. Since the wire was not anchored it was subsequently blown onto the trail and destroyed by heavy tractor swings prior to testing.

Trail wire was again laid over the same portion of trail during August under the supervision of the project leader. On this occasion trail flags were used as anchors. The trail marking antenna and receiver was installed on a Weasel for testing. Vehicle mounted equipment functioned well. However, wire maintenance caused considerable difficulties and continues to be a major problem with this type of trail marking system.

Project 8 - Crevasse Detection User Test (Project Leader: Lt. Ferguson, USAPR&DC). The Crevasse Detector Model T-1 was tested in conjunction with normal operations and training. Three geometrical arrangements of detectors (Y, L, and W) were tested and proven satisfactory. The modified receivers installed this season were superior to those used previously. The modified control system proved to be simpler and more efficient in operation.

Project 13.1 - Snow Structures; Cooling of Under Snow Camps (USASIPRE, Project Leader: Mr. James A. Bender, USASIPRE). A pilot study was initiated to determine the feasibility of drawing large quanities of cold air out of the Snow Pack to cool portions of

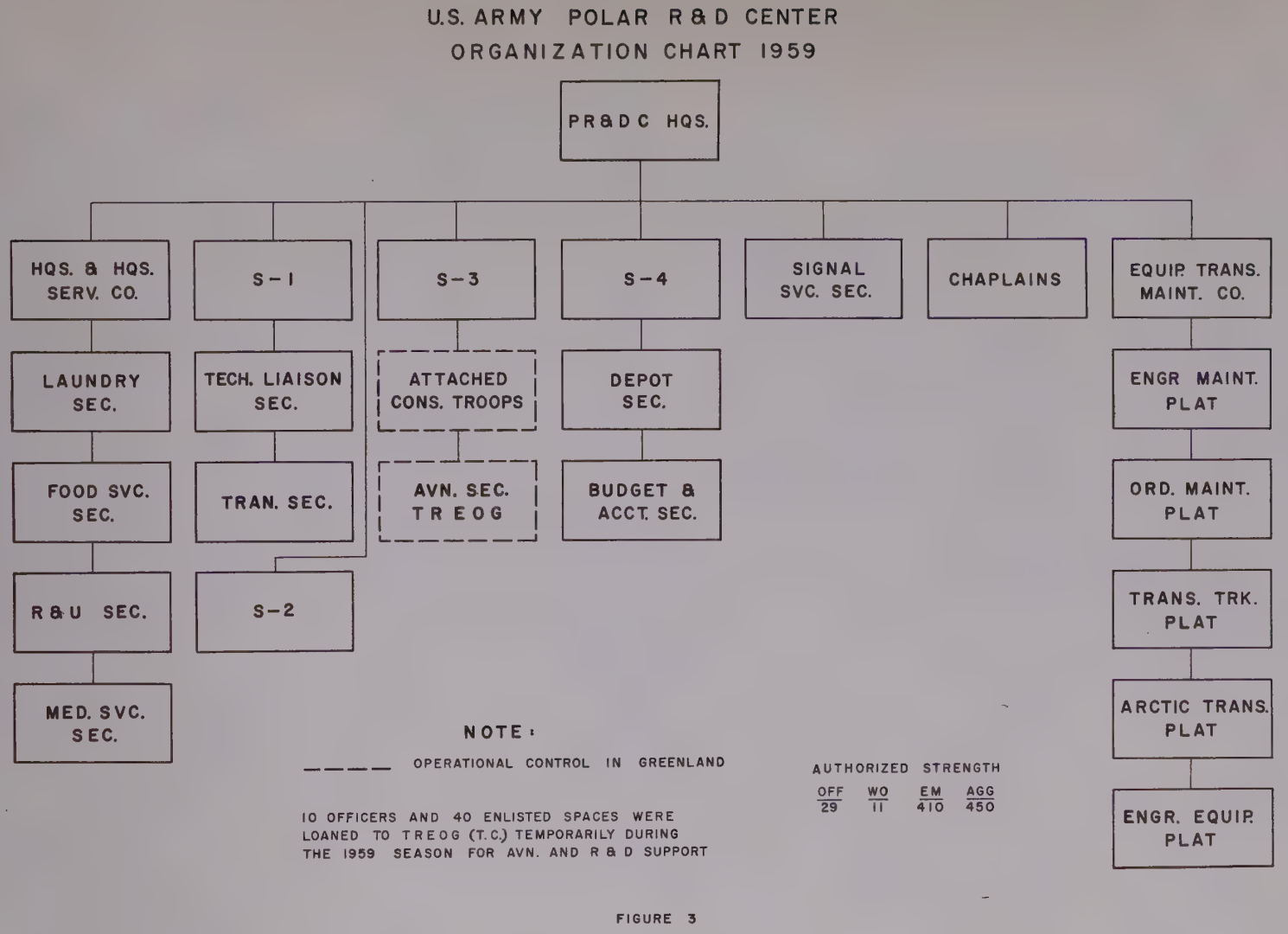

Figure 3. U. S. Army Polar Research and Development Center Organization , 1959

under-snow camps. A 5 HP Axivane fan was used on three different diameters and depths of air wells driven into the snow pack. Measurements recorded included output in cubic feet per minute of air, snow temperatures, snow permeability, ambient temperatures, and pressure drop over the fan. Interesting and useful data applicable to the construction of Camp Century was obtained from this portion of the project.

Project 13.2 - Snow Structures: Task 1 - Site II Resurvey and Snow Laboratory Studies (USASIPRE, Project Leader: Robert W. Waterhouse USASIPRE). Observations of subsurface excavations constructed in previous years were continued in an effort to determine distinctive deformation characteristics related to cavity size, shape, depth of cover, use, and other physical characteristics. These observations are expected to provide data from which the behavior of snow structures can be predicted. Studies conducted in the undersnow laboratory at Site II, during past seasons, were designed to facilitate the eventual standardization of tools and techniques to be used in determining engineering properties of snow.

Project 13.2 - Snow Structures: Task II - Snow Cutting and Moving Equipment (USASIPRE, Project Leader: Robert W. Waterhouse, USASIPRE). A complex of new snow cutting and moving equipment to be used in construction of under-snow camps was tested at Camp Century this season. Mechanical compatibility and efficiency tests were conducted on special high efection chutes and a precise guide device which will be used as accessories to the Peter Snow Miller. These items, when fully developed will enable the Miller to excavate extremely deep trenches here-to-fore impossible with standard cutting equipment. A machine designed to cut slots in trench walls to support roof arch forms was also tested. Test results indicate further modifications are necessary prior to additional testing.

Project 13.2 - Snow Structures: Task III - Hemispherical Shells (USASIPRE, Project Leader: Mr. Robert W. Waterhouse, USASIPRE). The construction of habitable, subsurface, hemispherical shelters has been proven feasible. This last season, hemispherical forms of several kinds (both rigid and nonrigid geodesic frames and air supported structures) were successfully tested for constructing this type of shelter. Modified hardware tests will be conducted in the future to improve techniques and to determine the feasibility of using

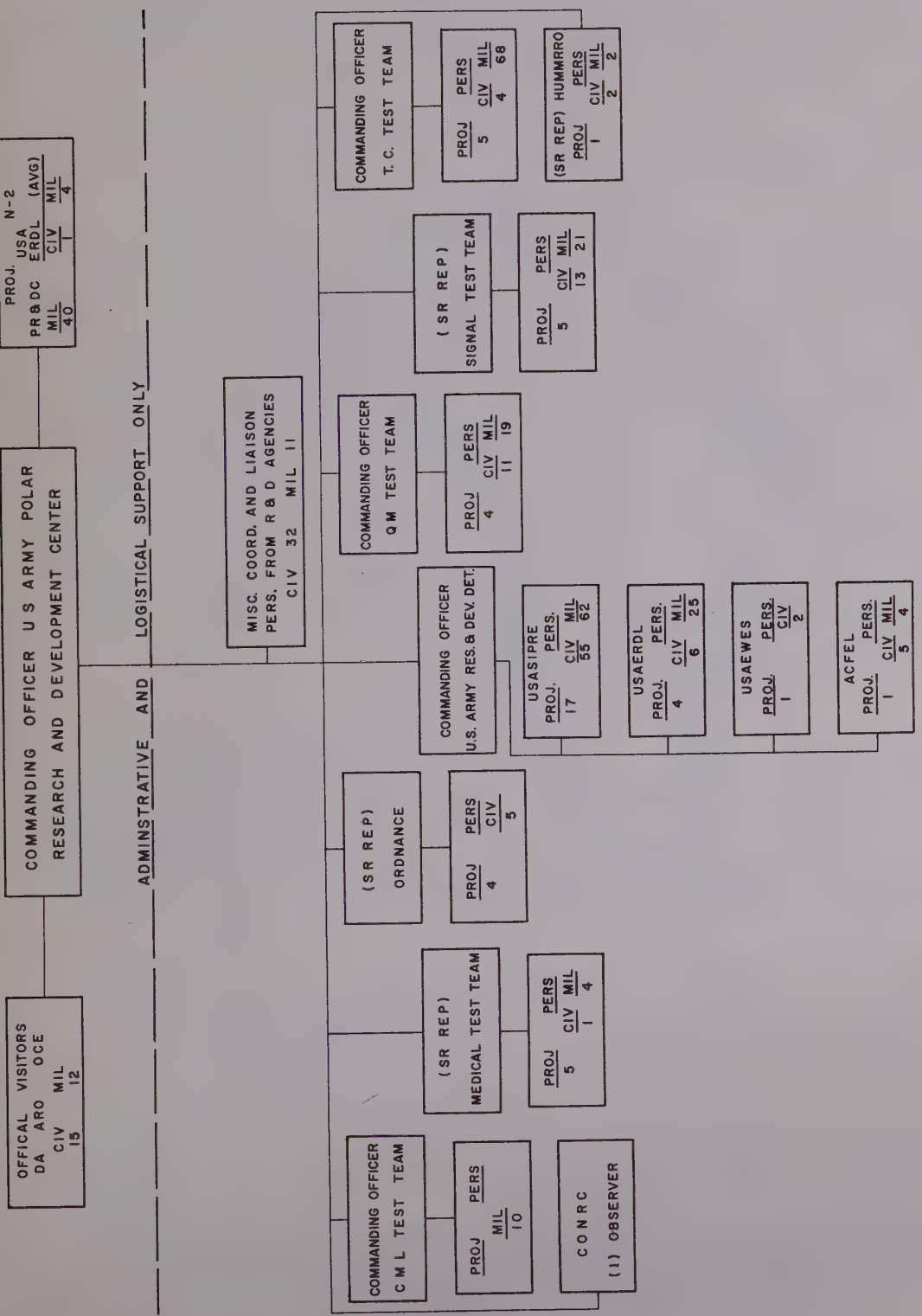

Figure 4. Project Organization, 1959

these hemispherical snow shells.

Project 13.2 - Snow Structures: Task IV - Mechanical Trench Covering. No field work conducted.

Project 13.2 - Snow Structures: Task V - Long Span Experimental Arches. No field work conducted.

Project 13.2 - Snow Structures: Task VI - Recording Deformation Gauge (USASIPRE, Project Leader: Mr. Robert W. Waterhouse, USASIPRE). Deformation of undersnow cavities has been measured for several seasons at Site II. To substantiate the theory that environmental factors having cyclical fluctuations do influence deformation significantly, periodic readings are required throughout the year. A measuring and recording system has been developed employing Beta Radiation from strontium 90, controlled to leave a trace on sensitized film in proportion to the differential movement between the source mounted on a wall and the film supported from a floor cavity. Time is indicated by periodic exposure from a second source controlled by a battery and clock triggered solenoid. Under-cut trenches at Site II have been instrumented with this device to measure relative displacement of 6 walls and one crown point.

Project 13.2 - Snow Structures: Task VII - Camp Century Test and Construction Observations (USASIPRE, Project Leader: Mr. Robert W. Waterhouse USASIPRE). Variations of the snow and climatic conditions will have considerable effect upon the construction and length of occupancy of Camp Century. Climatic conditions and general features of natural and disaggregated snow were observed and recorded for further evaluation.

Project 14 - Water Supply (USAERDL, Project Leader: Mr. Raul Rodriquez, USAERDL). The present method of producing water by use of snow melters has not proven adequate for populated icecap installations. The project objective was to test the feasibility of producing clear potable water in sufficient quantity to supply an icecap camp of approximately 200 personnel. Project equipment consisted of a steam generator, hose, steam nozzle and a submersible electric pump assembly. The steam nozzle assembly was used to penetrate 120 feet of permeable snow. At this depth a cavity containing water in sufficient amounts to supply the camp requirements

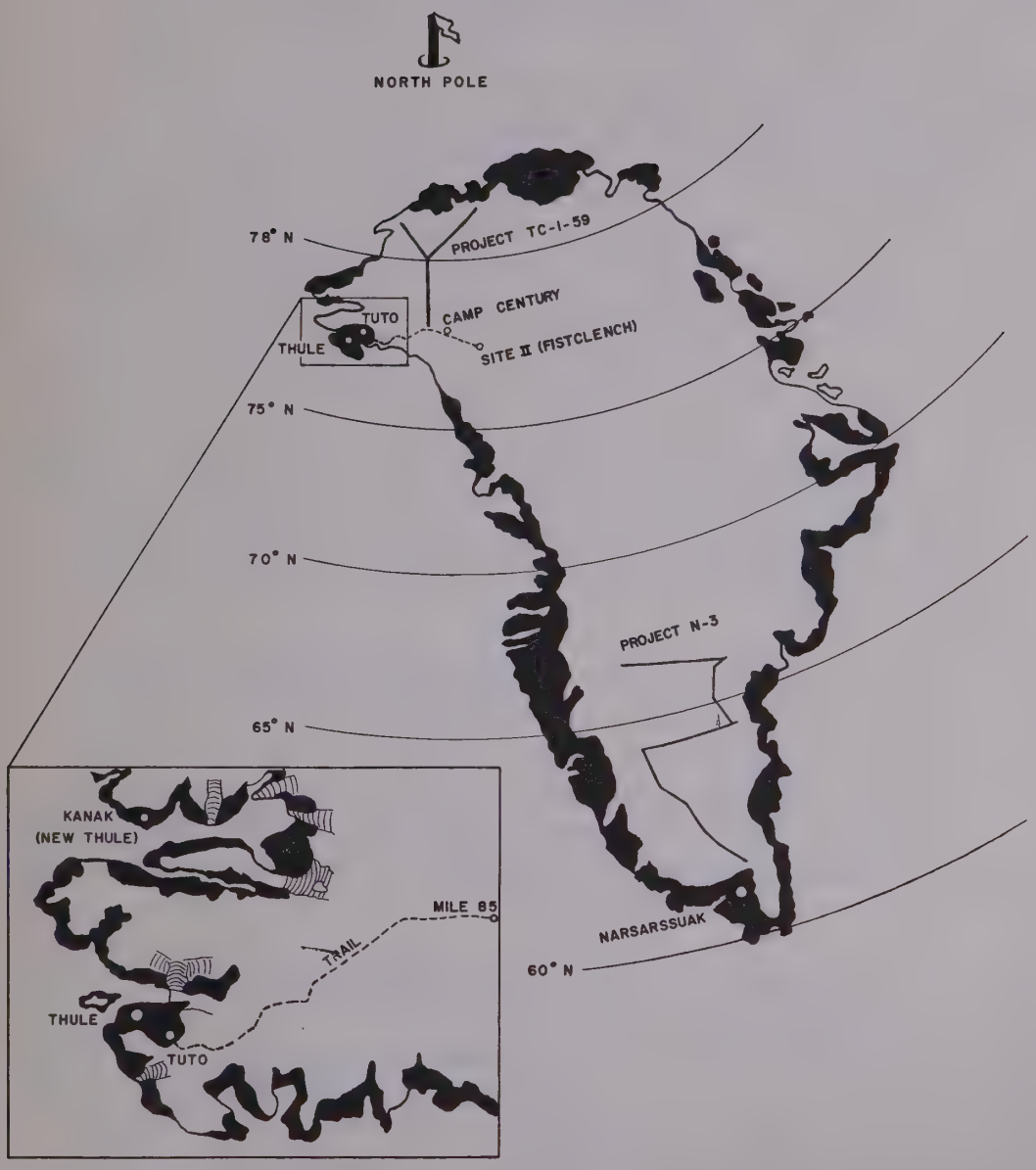

Figure 5. U. S. Army Polar Research and Development Center Camps and Research and Development Ice Cap Expeditions Active During 1959.

was formed in the impermeable ice. Approximately 107,700 gallons of water were produced for Camp Century's use during a 45 day period. All equipment used on this project is stored at the site to provide a permanent water supply system for Camp Century.

Project 22.1 - Tunneling In Ice (USASIPRE, Project Leader: Mr. John F. Able, USASIPRE). The basic project objective was to demonstrate military capability for excavation of large under-ice cavities which can be utilized for under ice camps. At the completion of the 1959 season, 30,500 cubic yards of ice had been removed from the ice tunnel, providing 25,000 square feet of floor space. Rooms were constructed for the erection of troop billets, messing facilities, water supply, bulk POL storage, sewage and waste disposal and electrical facilities. The Joy Continuous Coal Cutter supplemented by a Joy Loading Machine and a large expansible conveyor belt was used for all excavation work. The average rate of excavation was 32 cubic yards per man shift, approximately 1,920 cubic yards per week. Operations performed this season demonstrated the capability of constructing large under-ice cavities suitable for use as military camps in polar regions.

Project 22.2 - Ice Tunnel Instrumentation (USASIPRE, Project Leader: Mr. Theodore R. Butkovich, USASIPRE). Previously installed instrumentation in both ice and snow cavities were read and the effects of deformation photographed. Additional instrumentation was installed to indicate mass flow around openings. Special equipment was devised and installed in the ice tunnel (Project 22.1) to measure hydrostatic pressure and elastic stress.

Project 23.1 - Whiteout Studies (USASIPRE, Project Leader: Dr. R. W. Gerdel, USASIPRE). Observations were begun at Site II where temperature profiles, sodium chloride content and droplet size were measured during 9 whiteouts. Visibility and light transmission as well as incident, reflected visible and infrared light were also measured over a 19 day period. A movable laboratory was used to conduct further experiments along the Tuto - Site II Trail and in the vicinity of the ramp at Camp Tuto. The volume and quality of data collected on whiteouts and visibilities far exceeded that of previous years. Definite contributions to the control of whiteouts by cloud modification and to the forecasting of visibility should result from this season's work.

Project 25 - Deep Thermal Core Drilling In Ice (USASIPRE, Project Leader: Mr. M. J. Pollak, USASIPRE). The Thermal Core Drilling Project was requested and funded by the National Science Foundation. Drilling equipment was tested on the Ice Ramp at Camp Tuto to obtain preliminary experience and perfect equipment for a project to penetrate to the bottom of the Antarctic Ice Sheet at the Byrd and South Pole Stations. Due to the late decision to undertake the project this season, equipment delivery caused considerable delay. Once operations were begun, measurements were recorded of such parameters as: Penetration rates, electric power consumption, fuel consumption, meltwater temperature, and flow rates. Core lifting rates and loads, core and hole sizes and core characteristics were also observed. Upon completion of the project, the equipment was disassembled and prepared for shipment to the Antarctic.

Project 25.3 - Drill Hole Measurements (USASIPRE, Project Leader: Mr. B. Lyle Hansen USASIPRE). Complete data on the temperature, diameter, and inclinations were taken at 50 feet intervals to a depth of 1,348 feet in a 1957 drill hole at Site II. The results of such measurements are highly useful for Glaciological, Climatological, and Engineering purposes, by providing information on temperature changes and deformation of cavities in ice as related to depth.

Project 28.1 (a) - Aerial Photographic Techniques (USASIPRE, Project Leader: Mr. Ambrose O. Poulin, USASIPRE). The investigations of pattern ground phenomena continued with special emphasis on photographic identification of permafrost. Three new soil movement study locations were established this season at "B" Site and both new and old installations were photographed at regular intervals with a photogrammertric plotting instrument. Instrumentation included reference points for measurement control and thermocouples to record ground temperature gradients.

Project 28.1 (b) - Aerial Photographic Techniques (USASIPRE, Project Leader: Mr. Robert D. Leighty, USASIPRE). Observations and evaluation of the performance of structures, taxiways, and the runway at Thule Air Base continued. Data on design features of various types of structures, related foundation conditions and construction techniques were recorded for inclusion in a report to be published on "Engineering Application of Aerial Photography to Project

Blue Jay". In general, results of this survey indicate settlement in only 20 of 268 buildings on base. Slight settlement was evident in 13 buildings while the remaining 7 showed severe settlement requiring corrective action. This project is scheduled to continue through 1960.

Project 33 - Pile Testing (USASIPRE, Project Leader: Mr. Nicholas C. Costes, USASIPRE). Settlement measurements continued on pile groups installed at Site II in 1958. During August, four, four inch piles, loaded to 100 PSI last season, were unloaded and pits dug around their bases to determine the deformation profile of piles in snow. Blocks of snow containing the base profiles were returned to the USASIPRE Laboratory in Wilmette, Illinois, for final analysis. An additional phase of the project this season consisted of a series of confined compression test using samples of snow ranging in density from .48 g/cc to .68 g/cc. These samples were subjected to pressures of 50, 100, and 200 PSI to determine strain rates of snow at different densities, under various pressures. Data obtained from strain rates will be used to determine pile settlement.

Project 34 - Seismic Research (USASIPRE, Project Leader: Dr. Hans Roethlisberger, USASIPRE). Detailed seismic reflections begun in 1956 at Site II were continued. Preliminary evaluation of data indicates surface movement of less than 200 feet. Refraction velocities in shale, quartzite sandstone, and permafrost were measured in the Tuto area. The refraction method proved suitable for use in permafrost and sand stone. However, it was unsuitable in shale bedrock areas due to low velocity rates. Variable shot point distances were determined by registering reflection signals from surface explosions detonated on Petowik Glacier. Differences in the reflection characteristics of this survey and data recorded from a similar survey conducted in 1958 will be analyzed at a later date.

The "Soniscope", an electronic instrument designed for concrete testing, was used to measure travel times of ultrasonic pulses in ice and snow. Bariumtitanate transducers developed at USASIPRE were used with the soniscope and were tested under a variety of conditions. Pulse velocities were measured in sea ice immediately prior to break up and correlated to temperatures and salinity readings. Numerous measurements were also conducted using 46 transducers permantly installed in the 36 foot room of the ice tunnel.

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Project N-1 - Tunneling in Permafrost (USASIPRE, Project Leader: Mr. John F. Able, USASIPRE). The project objective was to determine the engineering criteria for design and construction of a tunnel in frozen glacial till. Standard hard rock mining equipment and methods were used to excavate 1,050 cubic yards of in-place till. Hole spacing, type of explosive, weight of powder, and fragmentation results, were recorded on each of 90 rounds fired. Powder consumption was approximately 5 1/2 pounds of explosive per yard of material blasted or 2 1/2 pounds of explosive per ton of broken rock. Productivity per man per shift averaged 1 1/2 tons. Additional tests were conducted to determine the adaptability of different types of drills, drill fluids, drill bits, and blasting patterns. The only mining problem encountered for which no solution is readily available was the poor fragmentation of the till when blasted.

Project N-2 - Camp Century (USASIPRE, USAERDL, USAPR&DC, Project Leader: Captain Thomas C. Evans, USAPR&DC). Camp Century was designed and is being constructed to meet 3 objectives; (1) to test new concepts of polar construction, (2) to provide a field test of a portable nuclear power plant designed to be installed and operated by army troops, and (3) to provide an adequate base in the interior of Greenland for the support of year-round research and development activities.

Camp Century is a subsurface installation. All buildings and facilities are housed beneath the snow in cut-and-cover tunnels to provide protection against the severe polar weather. These tunnels are constructed by cutting deep trenches with rotary snow plows, covering the open trenches with corrugated metal arches, and placing processed snow over the arches to form a strong and durable roof system. In most of the trenches the walls are sharply under-cut to yield a tunnel of maximum floor width with a minimum span of steel arch.

During 1959, 5 tunnels were constructed at Camp Century. These tunnels have a combined length of 2,500 feet. Interior widths at the floor vary from 18 to 26 feet and clear heights range from 20 to 30 feet. The longest single tunnel is the central communications trench which will serve as the "Main Street" of the completed camp. Paved with a timber roadway, this tunnel has a length of 1,000 feet. The most massive tunnel constructed in 1959 is the main equipment

trench which will house a portion of the nuclear power plant. Roofed with a 30 feet diameter semi-circular arch of steel and snow. Its size will permit housing much larger buildings than have been used in undersnow installations in the past.

Five permanent T-5 type prefabricated buildings were erected at Camp Century this season. These include 3 barracks capable of housing a total of 60 men, a latrine-laundry, and a dispensary. Foundations were installed for a mess hall and a water supply building, but these structures did not arrive in Greenland in time for erection in 1959. Prior to shipment to Greenland all Camp Century buildings are erected and all critical equipment and utilities are installed and checked. Each building is then disassembled, packed and shipped together with installed equipment so that it arrives at Camp Century as a complete unit.

Little work was accomplished on utilities this season. When complete, however, Camp Century will have very modern systems for power, water, and waste disposal.

A number of supporting R&D projects were active at Camp Century during 1959. These included: (1) Project 13.2 Snow Structures, USASIPRE (three tasks); (2) Project 14 Water Supply, USAERDL; and (3) A foundation study for the nuclear plant.

In 1959, Camp Century was closed for the winter on 1 September. Construction will be resumed in the spring of 1960. The most important element of the 1960 construction will be the installation of the nuclear power plant. Current plans call for completion of all essential facilities at Century by October of 1960, and continuous operation of the camp thereafter as a base for Polar R&D Activities.

Project N-3 - Structures of The Greenland Ice Cap, South Greenland (USASIPRE, Project Leader: Mr. Richard H. Ragle, USASIPRE). Part I - This project was similar in scope to projects conducted on the ice cap in previous seasons to collect data on snow accumulation, altimetry, annual temperatures and other meteorological phenomena. Project equipment and personnel were assembled at BW-8 and air lifted by C-130 type aircraft to Dye 2. The party departed Dye #2 on 9 June and traveled approximately 640 miles on a traverse of the south dome of Greenland arriving at the ice edge,

near Narsarssuak, on 25 August. Project resupply was accomplished by fly-in at Dye 3 and by air drop at mile 550. The equipment used on this project was cached on the snow surface 48 miles north of Narsarssuak.

Project N-3 - Structure of the Ice Cap, North Greenland (USASIPRE, Project Leader: Mr. Chester C. Langway, USASIPRE). Part II - Standard glaciological equipment were used in conducting 13 snow pit studies and 52 ram tests at systematic intervals during the 1600 mile Lead Dog Swing to Nyeboes and Peary Lands. Results of this study will determine the net snow accumulation over a 5 to 20 year period.

Unnumbered Engineer Projects.

Spread Footing Test, (EOD, Project Leader: Mr. Philipe Tilton, Metcalf and Eddy). Unscheduled spread footing tests were conducted by EOD at Camp Century this season. Four 12 feet square footings were constructed, two of which were loaded to approximately 2000 pounds per square foot and the remaining two supporting approximately 4800 pounds per square foot. Heat was applied to one footing of each load test. During a seven day period settlement due to heat became noticeable. During unheated periods, all footings were subsiding at the approximate rate of 0.002 inch per hour. Test footings remain in place for further observation in 1960.

Evaluation of the Site II Sewage System (USAPR&DC, Project Leader: Captain Patrick W. Marks, USAPR&DC). The project objective was to determine the degree of lateral seepage between the latrine and kitchen sumps at Site II. One packet of sea marker dye was dumped into the kitchen sump which was located 96 feet North of the latrine sump. Samples collected from the latrine sump on three consecutive days indicated no seepage between sumps.

A borehole TV camera was employed for visual inspection of the latrine sump, however, due to unsatisfactory lighting conditions a thorough inspection was not possible.

Human Resources Research Office

Project H-1-59 Test of Measurement Tools (Human Resources Research Office, Project Leader: Dr. William A. McClelland, HumRRO). The project objective was directed towards the development of: (1) hypotheses concerning the effect of the environment over time upon selected technical service troops and air defense crews; (2) improved tests and techniques to measure these effects; (3) specific proposals for human factors research activities directed towards the improvement of cold weather training and operational techniques.

The battery of tests consisted of: (1) interviews, (2) personality tests, (3) tests of mental ability, (4) manual dexterity, (5) problem solving, (6) perception, and (7) measurements of special and temporal orientation.

Tests were administered to groups of 12 men, test time per group was approximately 6 hours. During the season, a total of 139 men were tested from the USAPR&DC and attached units.

In addition to research and development personnel, 96 men from A, B, C, and D Batteries of the 7th Artillery Group (Air Defense) were administered the test battery.

It should be emphasized that the end products of this summer's work were only hypotheses, methods and proposals, not final conclusions. Observations and suggestions which were of immediate value to army personnel engaged in arctic training and polar operations were a welcome by-product.

Medical Corps

Numbered Medical Corp Projects.

Project MC - 1 - 59 Adaptation of Man to Polar Environment (USAMRL). No work was conducted.

Project MC - 2 - 59 Microbiology (USAMRL, Project Leader: Mr. C. DiGiovanni, Jr. USAMRL). The three-fold objective of microbiology this season was (1) to study selected sanitary problems

with emphasis on soil contamination by sewage, microbial content of water, and the potential seriousness of the fly situation, (2) to conduct general microbiological surveys of USAPR&DC's installations, and (3) to investigate the etiology of infected wounds in polar areas.

Repeated millipore analysis of Lake Tuto water failed to disclose enteric organisms. However, studies have shown a marked rise in noncoliform bacterial and continued chlorination is recommended. Microbiological assay of water from Site II was negative for enteric organisms or other pathogens. The general camp area at Site II was given a thorough analysis which resulted in the collection of numerous microflora specimens.

Soil specimens from the immediate vicinity of latrines and sanitary fill at Camp Tuto were also collected. Analysis of water samples from Camp Century revealed the presence of gram positive, staphylococci and proteus, approximately eight organisms per 100 cc. Chlorination of water was begun immediately.

Samples were collected from a host of areas not mentioned in this report including cryoconite pits. All samples from the various sites were returned to USAMRL Laboratories for analysis.

Staphylococci was isolated in two cases of infected wounds and cultures were returned to USAMRL for phage typing.

Project MC - 3 - 59 Psychological Studies. No work completed this season.

Project MC - 4 - 59 Investigation of Hematopoiesis (USAMRL, Project Leader: Major Richard F. Barquist, USAMRL). The project objective was to determine to what extent individuals living under ice cap conditions would develop "Arctic Anemia".

Blood samples were extracted from a group of personnel before, during, and after residence on the Greenland Ice Cap. Blood components were analysed from samples taken. Data collected from these test indicated no symptoms of anemia.

Unnumbered Medical Corp Projects.

Hearing on the Eskimo (USAMRL, Project Leader: Captain John Fletcher, USAMRL). A joint project was initiated between USAMRL and the Danish Physician at New Thule to determine the loss of hearing in the Eskimo, particularly those individuals not exposed to industrial noise. The actual test will be accomplished by the Danish Physician over the winter season.

Ordnance Corps

Numbered Ordnance Corp Projects.

Project ORD - 1 - 59 Fuels and Lubricants Testing (ORD, Project Leader: Mr. R. E. Engelharot, Southwest Research Institute). A survey was conducted of USAPR&DC and 7th Artillery Group (Air Defense) activities to determine the performance of Ordnance Corps equipment, fuels, and lubricants. These were observed under operational conditions at all USAPR&DC Camp locations. Observations and recommendations were submitted to the Commanding Officer, USAPR&DC.

Project ORD - 2 - 59 Human Engineering Studies. No field work conducted.

Project ORD - 3 - 59 Vehicle Over-Snow Mobility (ORD, Project Leader: Mr. William H. Clark, Ordnance Tank and Automotive Command). Shear tests were conducted to determine vehicle over-snow mobility by the project leader in conjunction with USAPR&DC swing activities. Data and photographs were taken by the project leader on each of the 12 tests conducted.

Unnumbered Ordnance Corp Projects.

Environmental Study and Research on Lower Fungi of possible Ordnance Signifigance in Northwest Greenland (ORD, Project Leader: Dr. Charles B. Lee, Ordnance Tank and Automotive Command). Numerous soil and air specimens were collected from numerous sites in Northwest Greenland. These were returned to CONUS for further analysis by the project leader.

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Quartermaster Corps

Numbered Quartermaster Corp Projects.

Project QM - 1 - 59 Micrologistics and Human Factors Involved in Small Unit Capabilities in Polar Areas (USAQMC, Project Leader: Dr. Thomas Dee, USAQMC). The project objectives were to conduct tests under polar conditions to determine the following: (1) The effect of three systems of material upon selected personnel groups in terms of time. (2) The operational factors and parameters which influence the effectiveness of these three systems of material. (3) The best methodology and procedures for use in assessing Quartermaster Corp equipment for polar conditions on a system basis. Three microlog stations were constructed below the snow surface near Site II. Stations were located in different directions (NE, SE, and W) 5 miles distance from the main camp. The three task teams, each composed of 6 men, experienced three different living conditions dictated by the different equipment and rations at each station. Tests were conducted with the men on the snow surface exposed to the elements and equipped with Quartermaster material issued at each station. Teams were rotated between the sites weekly. Data on meteorology and Quartermaster equipment was returned to the Quartermaster Research and Engineering Command Laboratories for further evaluation.

Project QM - 2 - 59 Polar Field Service Center (USAQMC, Project Leader: Mr. John Bergin, USAQMC). The feasibility of employing special complexes of Quartermaster service equipment in polar regions was demonstrated this season by the installation of a laundry unit at Camp Tuto.

A further study was conducted to determine requirements for dry cleaning and clothing repair units under conditions prevailing on the Greenland Ice Cap.

Project QM - 3 - 59 Human Factors Research of QM Problems Associated with Missile Operations and Ice Tunnels (USAQMC, Project Leader: Branch Chiefs). An attempt was made to gain insight into Quartermaster problems which might arise at missile bases located in ice or snow tunnels. Work this year consisted of interviews with the Commanding Officer, 7th AAA Bn. and with SIPRE scientists engaged in the subsurface snow and ice projects.

Project QM - 4 - 59 Micrometeorological Studies (USAQMC, Project Leader: Dr. Thomas Dee, USAQMC). Micrometeorological measurement of the vertical temperature distribution and wind speed was collected in conjunction with the Signal Corp meteorological team operations. Other standard and non standard weather elements were recorded to obtain data useful in determining the magnitude of meteorological perameters which impose peculiar restrictions on ice cap operations.

Signal Corps

Numbered Signal Corp Projects.

Project SC - 1 - 59 Meteorological Support (USAEPG, Project Leader: Lt. Samuel R. Moore, USAEPG). Two meteorological stations were operational in the Tuto area and one at Site II. Standard weather observations and temperature measurements both above and below the ground surface were recorded hourly at all stations. Rawinsonde flights were conducted daily at the Site II station. Two observers from the USAEPG accompanied the Lead Dog expedition (Project TC-1-59). Standard observations were recorded at six hour intervals. Pilot balloon flights were conducted daily during the trip.

Project SC - 2 - 59 Meteorological Stations, Upper Air (USASRDL, Project Leader: Dr. Helmut Weickman, USASRDL). Construction was begun on three year-round stations, with the erection of 100 foot, AB 216 instrument towers at the Tuto East and Tuto West locations. The third tower was transported to Site II. However, due to the uncertainty of year-round operation at Site II after completion of Camp Century, the tower was stored at Site II for the winter. In addition to tower erection, two T-5 buildings and a TO type generator building were constructed at Tuto West in preparation for year-round activities beginning in 1960.

Project SC - 3 - 59 Geomagnetic Measurements (USASRDL, Project Leader: Dr. Helmut Weickman, USASRDL). No field work was conducted, other than a reconnaissance for possible site location in the vicinity of Thule-Tuto.

Project SC - 4 - 59 Gianinni Data and Integrating System (USASRDL, Project Leader: Dr. Helmut Weickman, USASRDL). No field work conducted.

Project SC - 5 - 59 Mapping of Snow Drift Areas (USASRDL, Project Leader: Mr. John Kelly, USASRDL). Due to limited air support, only two missions were flown in conjunction with this project this season. Photographs were taken of drift areas between Tuto and Site II along the marked tractor trail.

Project SC - 6 - 59 Atmospheric Electricity (USASRDL, Project Leader: Dr. Helmut Weickman, USASRDL). Special radiosonde balloon flights were made at Site II during August to measure atmospheric electric and particle content. Also various methods were used to measure particle content in arctic air contaminated by precipitation and fog.

Transportation Corps

Numbered Transportation Corp Projects.

Project TC - 1 - 59 Experimental Polar Transport Operations (USATREOG, Project Leader: Captain Harold M. Munsel, USATREOG). Project Lead Dog departed Camp Tuto on 15 May 1959 to Nyeboes Land and Peary Land. A marked trail was established to these areas in conjunction with the primary mission of gathering scientific data including snow and ice studies, collecting meteorological data, determining altitudes, and plotting astronomical positions. The party was composed of 4 officers, 7 civilians, and 34 enlisted men from various technical services. The Lead Dog expedition traveled 1,578 miles during a 78 day period, returning to Camp Tuto on August 1959.

Project TC - 2 - 59 Environmental Testing of Oversnow Equipment (USATREOG, Project Officer: Captain James C. Trice, USATREOG). The Overland Train was tested to determine its limitations and capabilities of transporting heavy cargo over the Greenland Icecap. During the period 19 May to 29 July 1959, the train completed 7 round trips to PR&DC ice cap camps. On these trips the train traveled 1,400 miles and transported 355 tons of cargo. Due to mechanical failure of a generator shaft the equipment became inoperable and was returned to CONUS for repairs.

Unnumbered Transportation Corp Projects.

Project Sea Ice Reconnaissance (USATREOG, Project Officer: Major Antero Havola, USATREOG). The project mission was to determine the feasibility of mounting track vehicular swings over sea ice along the west coast of Greenland, during the early spring of 1960.

A field party from TREOG departed Thule on 23 April by helicopter to conduct a sea-ice reconnaissance from Thule to Kane Basin.

Considerable variations in ice densities were found. Tests indicate land-fast ice will support light wheeled and tracked vehicles from Thule to the vicinity of Pitorarfic. At Cape Alexander, land-fast ice is nonexistent except during the months of March through May in exceptionally cold winters. These facts were substantiated by native observations over a period of years.

Project Sky Cap (USATREOG, Project Officer: Captain Arthur W. Roberts, USATREOG). The project objective was to familiarize TREOG pilots with polar flying and survival techniques.

Flight training consisted of actual aircraft operation on the ice cap with emphasis on depth perception, navigation, safe altitudes, forced landings, autorotation over snow areas, snow blindness and take-off and approach techniques.

A practical exercise was conducted on arctic survival, including construction of snow shelters, wearing of arctic gear, skiing, and snow-shoeing. This portion of training took place on the ice cap under actual survival conditions.

Project Flying Frog (USATREOG, Project Officer: Captain Arthur W. Roberts, USATREOG). Operation Flying Frog provided air transportation for conducting scientific sea ice studies in Robeson Channel and Lincoln Sea. Using the TREOG base camp at Nyeboes Land, an aerial reconnaissance was flown over Lincoln Sea. Sea ice in this area was found to be so rough that aircraft landing was impossible.

Ice conditions at Robeson Channel were adequate for aircraft landings, and physical and chemical tests were made on the ice.

Data collected will be valuable to TREOG in project planning for 1960.

United States Continental Army Command

Project CONARC - 1 - 59 Small Unit Operation (CONARC, Liaison Officer: 1st Lt. Joe E. Delk, Company D, 1st Battle Group, 12 Infantry). No field exercise was conducted this year, however, the Liaison Officer was present in Greenland to observe activities and facilitate planning for a platoon size operation in 1960.

VI. SUMMARY OF SUPPORTING OPERATIONS

The magnitude of the 1959 program greatly increased Center responsibilities for command supervision logistical support, equipment maintenance, camp construction and ice cap swing operations. Particular emphasis was placed on safety, project support, and supply economy. This was the first season in which no major accidents occurred. Minor accidents were also reduced over previous years experiences.

This was the first season in which support was rendered to all Technical Services. However, project support was reasonably successful because of early and careful planning.

Excellent progress was made toward constructing proper housing, messing, and utilities to support year-round operations. Progress can also be reported in solving camp sanitation problems through the close supervision of the sanitary fill. A new sewage treatment plant was also partially completed.

Continuity was maintained through retention of key officer and NCO personnel. Most replacements were in the lower enlisted grades and these came directly from basic training units.

In addition to Camp Tuto two other camps located on the ice cap were operated in support of the program. The central ice cap camp at Site II was operated for the entire season. It supported a maximum of 130 persons and 13 projects. R&D projects at Camp Century were limited to those contributing directly to camp construction.

Approximately 600 personnel and 45 official visitors were housed at Camp Tuto.

Two ice cap trail parties were active this season: Lead Dog from Camp Tuto North to Nyeboes and Peary Lands; and Structure of Greenland Ice-Cap from Sondrestrom South to Narsarssuak. This again proved the capability of supporting R&D projects at any geographical location in Greenland.

The Finance Section USAPR&DC supported approximately 900 Army personnel engaged in R&D and SUNEC Operations. Financial activities during 4 1/2 months involved $375,000 in cash disbursements.

Shipment of supplies and equipment from the United States totaled 7000 measurement tons by water and 525 short tons by air. Supplies moved from Camp Tuto to ice cap camps totaled 1,300 short tons (including 900 tons to Camp Century). Over 350 tons of the total ice cap tonage was moved by the Transportation Environmental Operations Group in conjunction with testing of the overland train (TC-2-59), and the remainder was transported by PR&DC swings. Passengers to and from ice cap camps, aboard PR&DC swings, totaled 526.

Limited air support for the 1959 program was provided by TREOG Air Section. Equipment consisted of one L20 and one UIA ski-equipped fixed-wing aircraft, three H-19 and one H-34 helicopters.

Equipment maintenance and operation continued to represent a large portion of the Center's effort. Major items of equipment used included: fifteen 16-ton trucks, eleven crane-shovel units, seventeen D-8 and D-9 LGP tractors, fourteen D-8 bulldozers, forty-eight jeeps, thirty-two weasels and approximately 150 other pieces of fuel-consuming equipment and many miscellaneous and specialized pieces of towed equipment.

Construction accomplished during the 1959 season by Center personnel and a construction platoon from the 588th Engineer Battalion (CONS) far exceeded any previous effort in support of the Greenland program. Approximately 95,900 cubic yards of non-frost susceptable fill was placed for new building foundations. A 70x2600

foot runway was completed, including surfacing. Numerous storage pads were constructed and many miles of roads were maintained. Additional construction at Camp Tuto included: a new mess; a latrine-shower; and a generator building. A water supply system was installed from Lake Tuto to the camp water supply building. Twenty-five T-5 prefabricated buildings were erected to provide 19 troop billets, 4 maintenance shops, an orderly room and 2 meteor ological station buildings. In addition, extensive repair and winterization was accomplished on the aircraft hangar during the season.

VII. COMMANDER'S SUMMARY

The success of the 1959 season should be directly attributed to the following factors:

a. Close coordination and excellent cooperation of all agencies involved in planning the 1959 program.

b. Early arrival of officers and NCO replacements permitting an adequate familiarization period.

c. Publication of AR 70-15 which establishes policy and guidance for technical service and research agencies engaged in the Polar R&D Program.

d. Excellent relationship between military and civilian personnel engaged in the R&D Program.

J. H. KERKERING
Colonel, CE
Commanding

Date Due